Exclusive ρ^0 Production in Ultra-Peripheral Collisions at $\sqrt{s_{NN}} = 200$ GeV/nucleon

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Coherent ρ^0 production in ultra-peripheral relativistic heavy-ion collisions (UPC) at $\sqrt{s_{NN}} =$ 200 GeV/nucleon was observed at STAR in the year 2001. Two data sets were collected using dedicated UPC triggers.

To study ρ^0 production accompanied by mutual nuclear excitation, $AuAu \rightarrow Au^{\star}Au^{\star}\rho^0$, about 2 M UPC minimum bias triggers were collected. Here, the coincident detection of neutrons from nuclear break up in the zero degree calorimeters (ZDC) is required. Low multiplicity UPC events are separated from high multiplicity hadronic collisions by the number of tracks hitting the central trigger barrel (CTB). To enhance the statistics of UPC minimum bias events, the STAR silicon vertex tracker was not read out to keep the event size and the DAQ readout time small.

For the analysis of ρ^0 production with both nuclei remaining in their ground state, $AuAu \rightarrow AuAu\rho^0$, a low-multiplicity topology trigger is used, which does not require a ZDC signal. At the first trigger level, the CTB is divided into 16 coarse pixels and topology requirements are imposed on low multiplicity pixels. About 1.55 M topology triggers were collected in 2001.

The pair transverse momentum spectrum is shown in Fig. 1a for the minimum bias events and in Fig 2a for the topology trigger. Both spectra are peaked at $p_T \sim 50$ MeV, which is the signature for coherent coupling to both nuclei. The shaded histograms are normalized background models from like-sign combination pairs. The $M_{\pi\pi}$ invariant mass spectra of coherent ρ candidates at pair $p_T < 150$ MeV in Fig. 1b and Fig. 2b show clear ρ peaks. Both spectra are fit (solid line) by a relativistic Breit-Wigner for the ρ, a contribution from direct $\pi^+\pi^-$ production (both dashed), their interference, and a polynomial contribution for the background (dash-dotted). The ρ^0 mass and width are consistent with the known values.

The present plots correspond to about 20% of the total 2001 minimum bias and 3% of the topology data; the reconstruction of the full data set is in progress. The 2001 minimum bias data contain about 3000 ρ events and the topology data about 25,000 ρ events, corresponding to 10 and 50 fold increase of the statistics w.r.t. the 2000 data.

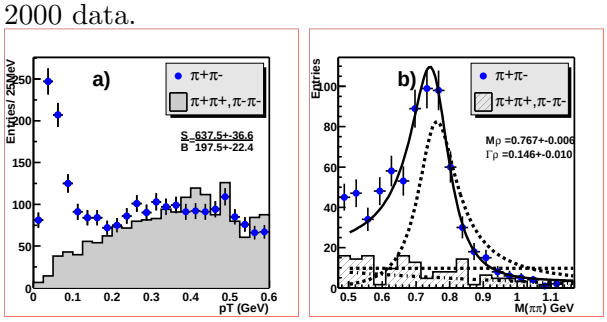

Figure 1: The p_T (a) and the $M_{\pi\pi}$ (b) distribution at $p_T < 0.15$ GeV for ρ candidates from $\sim 20\%$ of the 2001 minimum bias data.

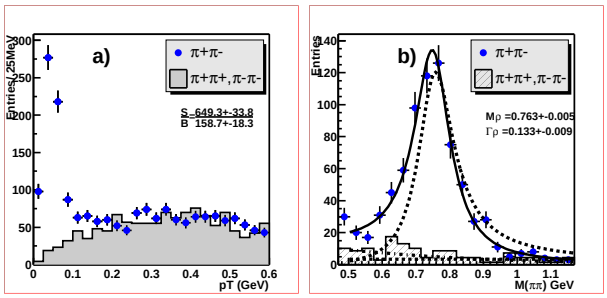

Figure 2: (a) The p_T (a) and $M_{\pi\pi}$ (b) distribution at $p_T < 0.15$ GeV for ρ candidates from $\sim 3\%$ of the 2001 topology trigger data.

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